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The Importance of English and Mathematics Efficiency as a Basis for the Mastery of Science

Anderson Harrison

THE IMPORTANCE OF ENGLISH AND MATHEMATICS EFFICIENCY AS A BASIS FOR THE MASTERY OF SCIENCE

HARRISON

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THE IMPORTANCE OF ENGLISH AND MATHEMATICS EFFICIENCY AS A BASIS FOR THE MASTERY OF SCIENCE

By

Anderson Harrison

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DEDICATION

The writer dedicates this paper to his wife, Mrs. Lucille O. Harrison and his daughter, Andrea L. Harrison.

A. H.

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CHAPTER I

NATURE OF THE PROBLEM AND DEFINITIONS OF TERMS USED

A. INTRODUCTION

"You can do it if you try!" has become almost a by word in our schools and homes as we urge our children to greater effort. It is hard to say how an idea became so widespread and still could be so wrong, for it would appear to be ill-advised to say to every child as he approaches each new hurdle that he can conquer it merely by putting forth enough effort. Obviously, every child cannot do some things, no matter how hard he tries!

Some students just do not have the level of abstract intelligence that will permit them to learn at the same rate as many others in their group.

Success or failure in any subject area may be due to a strength or weakness in some basic learning skill.

The question which may well be asked immediately is whether or not the prediction of the future status of the individual is really possible. The answer would seem to be that perfect efficiency of prediction is not possible, but it is feasible to speak concerning an individual's probable chances of reaching a specific level of achievement or adjustment. However consideration must be given to all

variables which will influence the individual's progress.

Each year colleges and universities find that a few students with very low entrance test scores or ranks in high school graduating classes are successful in academic work; also, a few who score very high prove to be failures as students. In general, however, one can say that the chances of success are good for the high ranking student and poor for the low ranking student. Prediction in the perfect sense is not possible in the above situation or in most other situations, but prediction in terms of estimating chances for success is inescapable in human affairs.

In guiding pupils--and in selecting science students, with particular reference to this report, the basic factors necessary for success should be known.

The investigation with which this manuscript deals was effected to determine the degree of correlation between English and mathematics efficiency and success in the study of science at the Lincoln High School, Port Arthur, Texas. It is hoped that through this report a little more of the uncertainty can be eliminated from the prediction process.

B. Statement of the problem. The purposes of the problem were:

1. To determine the degree of correlation between science comprehension and English and mathematics efficiency.

2. To find factual information that will be useful in guiding and selecting science students.

C. Limitations of the problem. This problem is restricted in scope in that it was limited by the following factors:

1. Only forty tenth grade senior high school students were used as subjects.

2. Chemistry and biology courses were the only scientific offerings given consideration.

3. Lincoln High School, Port Arthur, Texas, was the only school involved.

4. Achievement during the school year 1958-59 formed the superstructure of the investigation.

D. Background of the study. Six years of teaching chemistry and biology has convinced the investigator that interest alone is not sufficient for the mastery of science. All who have the interest may not have the ability. The writer has seen students with great interest fail to succeed in science and students of little manifested interest succeed in science.

The ability to succeed without manifesting interest and the inability to succeed with interest seem to indicate a neglect of certain factors which appear to be basic to

adequate educational prediction in the case of scientific study. More specifically, this study sought to find out whether English and mathematics efficiency has any bearing on success in the study of science.

E. Methods of study. Data for the study were obtained through a variety of research tools. However, the major technique involved an analysis of present and past records of tenth grade students in chemistry and biology at the Lincoln High School for the purpose of determining the degrees of correlation between (1) chemistry and mathematics and chemistry and English on the one hand, and between (2) biology and mathematics and biology and English on the other.

The scores in English and mathematics from the California Achievement Test, administered under the guidance of the Testing Director at Lincoln High School in September, 1959, were used to determine the achievement of students in English and mathematics. Science achievement was determined by the evaluations of teachers of the classes in chemistry and biology for the school year 1958-59.

Personal interviews with students and teachers of science were conducted to obtain their opinions as to the

importance of English and mathematics as a basis for science success.

It should also be mentioned that throughout the investigation professional literature shown to be relevant to the present study was constantly reviewed.

F. Definitions of terms used

Science. General inorganic chemistry (high school); fundamental biology (high school).

Mastery. The ability to make a grade above "C".

Efficiency. The ability to make a normal score equivalent to one's grade level in the subject area as indicated by the California Achievement Test.

Coefficient of correlation. An index of relationship which shows how well two measures do or do not vary together. The coefficient that was used in this study was Pearson's Correlation Coefficient:

$$r = \frac{\frac{1}{N}\sum XY - \bar{X}\,\bar{Y}}{\sqrt{\frac{1}{N}x^2 - \bar{x}^2}\ \sqrt{\frac{1}{N}Y^2 - \bar{Y}^2}}$$

CHAPTER II

REVIEW OF THE LITERATURE

Success in quantitative or mathematical reasoning appears to be the single factor most clearly and closely related to success in training for science. The ability to recall formulas or standard processes, does not seem to reveal the potential scientist as well as tests that require reasoning in solving problems. Verbal comprehension, according to Brown and Johnson, is another factor to test for. The student must be able to reason and read to become a scientist. All who have the interest may not have the ability.[1]

Topp says:

> Teachers and parents should not require of all children the attainment of indentical standards of achievement. Some children have special skills that should permit them to go far beyond any average standards. Others have deficiencies that will not permit them to attain those standards. Each must have standards within his limits.[2]

Brown and Johnson[3] found, too, that standard tests are one of the instruments used to identify the rapid

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[1]Kenneth E. Brown and Phillip G. Johnson, "The Talented in Mathematics," Bulletin No. 15, U.S. Office of Education and Health, 1952, pp. 2-13.

[2]Robert F. Topp, "You Cannot Always Do It If You Try," Elementary School Journal, December, 1953, pp. 230-34.

[3]Ibid., pp. 2-13.

learners in mathematics and science. They are especially helpful in identifying the superior child who is recitation shy or who has a language handicap. Such tests also bring into proper prospective the pupil who appears talented by comparisons to retarded classmates.

In order to get parents' reactions on what they wanted in a good school for their children, the American Committee on Educational Ideas contacted 380 parents. All indicated that children must learn to read, to write, and to use numbers. Some parents said that drills in these areas are important and should not be neglected, because of their relevance and the mastery of other essentials.[4]

Orleans and Wandt gave a test to 1000 teachers in a widely separated geographical area. Some of the items covered were: (1) long division, (2) long multiplication, (3) division by fractions, and (4) reducing and lowering fractions. The results showed that: (1) 11 per cent showed a lack of understanding, (2) 14 per cent--difficult to interpret, (3) 49 per cent--clear understanding, and (4) 26 per cent--not acceptable as answers. An explanation of the above shows that these people used methods as though they

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[4]Myron Cunningham, "Parents Want--A Good School Day for Their Children," Child Education, September 1954, pp. 13-17.

were processes themselves. As a result, rote memory was practiced and the complete process was never really learned.[5]

Benjamin says that scientific method so called is mainly a collection of exact descriptions of what men do in controlling and understanding natural forces. Descriptions in what form? In language, of course, a precise language, using words with exactly understood meanings:

> All children need effective instruction in reading. Children whose learning rate is low because of their retarded mental growth need special and excellent instruction if they are to develop into contented and useful citizens. They need an understanding, sympathetic teacher, who has insight into their handicap. With love and patience she will attempt to develop a level of reading ability that will enable these individuals to take their places in society and contribute their share to its welfare.
>
> Slow learning children like normal children sense the need for reading both in their school life and their outside experiences. Indicative of this is the use of often-repeated questions, "What does it say?", among children whose interest and comprehension of reading is above their achievement in the mechanics of reading. Reading for pleasure as well as for information and protection will play an important part in the life of the slow learner as well as the average.[6]

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[5]Jacob S. Orleans and Edwin Wandt, "Do Teachers Understand Arithmetic," Elementary School Journal, LIII, May 1953, pp. 501-7.

[6]Harold Benjamin, "Understanding Science," The Modern Language Journal, XXXVII, November 1953, pp. 327-30.

Russell supports this contention when he suggests that there is considerable evidence that one's reading is not a purely intellectual response, but an activity influence by perception, learning and recall, problem solving, and judgment, all of which may be involved in reading. May the child's or adult's reading also influence his perception, his concepts, his problem solving and his creative activities? Is reading a small or large influence on a person's thinking?[7]

Turning again to quantitative reasoning, according to the 1954 report of the Commission on Post-War Plans, a two track plan was proposed for mathematics. One track was supposed to insure mathematical competence for the ordinary affairs of life as a part of a general education appropriate for the major fractions of the high school population. The other track was supposed to provide sound mathematical training for our future leaders of science, mathematics, and other learned fields.[8]

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[7] David H. Russell, "Related Research in Reading," Elementary English, October 1954, p. 336.

[8] William A Gager, "The Changing Mathematics Program," N. E. A. Journal, October 1951, p. 458.

Partly as a result of the report, the trend in secondary mathematics today appears to be toward the two track system. Both the functional track and traditional track will run through high school. Traditional mathematics will consist of algebra 1 in the ninth, algebra 2 in the tenth, planegeometry in the eleventh; and trigonometry and solid geometry in the twelfth.

"Functional mathematics" means that the basic mathematical concepts, principles, procedures, and skills for a particular course must be so thoroughly woven into the fabric of that course, and the materials so carefully balanced between theory and socialized practices, that understanding, insight, and mastery of its application will be a reality.[9]

Salvadori says:

> Mathematics is the common language and common tool of all science, upon which our world is coming to rely more and more. We live in a civilization that demands the mass production of scientific achievement. This in turn demands mathematics. Mathematics is the language that has made possible the rapid progress in modern science. In past years, scientific strides were made by a solitary genius here and there unveiling a bit of the mystery of the world. Today quite ordinary fellows, working teams, communicate through mathematics, and using mathematics as a tool, bring about tremendous technological advances.

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[9] Gager, op. cit., p. 458.

> This is how mathematics came into being. Men set themselves a problem imaginatively and solved it. One of the best ways to learn mathematics is to discover its truths for yourself.[10]

The general trend of the research findings clearly indicates the importance of including a measure of mathematical proficiency in any test battery used in the counseling of prospective engineering students.[11] The median of the various coefficients of correlation, which were obtained by comparing the first year records of engineering students with their performance on mathematics achievement tests, is .56. When the test scores are compared with advanced achievement, beyond the first year, the median r is .44. These findings would seem to substantiate the prevailing opinions that mathematical ability is basic to success in engineering training and that high scores on mathematical achievement tests, constitute the best single indication that an individual will complete such training successfully. On the other hand, consistently low mathematical grades and test scores should be

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[10] Mario G. Salvadori, "Math's a Pleasure," Harpers, August 1954, pp. 88-91.

[11] Dewey B. Stuit and others, Predicting Success in Professional Schools (Wisconsin: George Banta Publishing Company, 1949), pp. 30-34.

regarded as indicating that the counselees will encounter serious difficulty in the pursuit of engineering studies.

Data on the sciences appear to follow much the same trend and indicate that there is a significant relationship between general proficiency in science, as measured by standardized achievement tests, and success in mathematics.

Probably as a result of the necessary emphasis given to the factors of mathematical and scientific proficiency and their essential relationship to successful performance in an engineering training program, counselors and prospective engineering students frequently tend to overlook the fact that such success also presumes competency in the field of English. The engineering student must be able to manipulate verbal, as well as mathematical symbols, if he is to comprehend fully the significance of lecture materials and technical literature and to express adequately the results of his work.

The nature of science and mathematics makes the integration of these subjects natural and favorable. The history of both fields indicates development through the union or combination of the two. Mathematics has assisted in the development of science in three ways;

namely, as a means of communicating, as way of thinking, and a means of problem solving.

The vocabulary of science is a common source of difficulty and confusion as any teacher can testify who has checked a science book for essential words and checked a pupil's understanding of essential terms he thought had been mastered.

The problem is the more serious by reason of the fact that much science is compact, terse, concise, and tightly bound. Words, symbols, abbreviations, and punctuation marks cannot be safely overlooked. The pupil must read slowly and intensively, allowing time to weigh meaning, refer back mentally to earlier elements and establish relationships among them. Science is not a "guessing game" and careless, indifferent reading has no place here. Usually not a single, casual reading can be done. Students need training in re-reading, to see places of partial and complete re-reading to judge when no further re-reading is required.

Students have difficulty with the technical language. Symbols, formulas, graphs, and diagrams with which facts of science are recorded need to be read. The facts themselves are often supreme sources of difficulty in themselves.

The necessity of making facts and principles comprehensive may be explained to pupils in some such fashion as:

> We shall gain must from our study of science if we use the scientific method of thinking. The scientist examines each fact... He keeps these facts in mind. He notes relations between them, and notices whether they support a certain theory. Our understanding of the laws of science grows as we find fact after fact that makes the theory seem true. To build up, in this way, our knowledge of science requires careful, thoughtful reading. This is not a place for skimming or skipping.[12]

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[12] American Association for the Advancement of Science, Mathematics and Science Education in U.S. Public Schools, (Washington: United States Office of Education, Circular 1958, No. 533), p. 6.

CHAPTER III

AN ANALYSIS OF THE DATA

A. Determining the degree of relationship. Once an acceptable criterion of success has been established, the prediction factors associated with individual differences in the performance of the activity must be identified and measured. The next step is that of determining the degree of relationship between the prediction factor and the criterion. The closeness of the degree of relationship determines how accurately predictions can be made. If a given prediction factor (or combination of factors) is closely associated with success in an activity, the counselor can make accurate prediction: if the relationship is low, the counselor will have to proceed with caution because there evidently are many "unknown factors" which are just as important as the measured factor.[13]

Coefficients of correlation range over a scale which extends from -1.00 through 0.00 to 1.00. A positive correlation indicates that large amounts of the one variable tends to accompany large amounts of the other; a negative

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[13] Dewey B. Stuit and others, Predictions, Success in Professional Schools (Wisconsin: George Banta Company, 1949), pp. 30-40.

correlation indicates that small amounts of the one variable tend to accompany large amounts of the other.[14]

A zero correlation indicates no consistent relationship. Only rarely, if ever, however, will a coefficient fall at either extreme of the scale, at 1.00 or -1.00. In most actual problems, calculated r's fall at intermediate points, such as, .72, .26, .50, etc. Such r's are to be interpreted as high or low depending in general upon how close they are to ±1.00.[15]

B. A statistical analysis. Table I--Coefficient of Correlation: English and Chemistry--on page 19 shows the English grades of 40 students as revealed by the California Achievement Test and the final grades in chemistry on the tenth grade level. The mean score in English is 10.83 and the mean score in chemistry is 74. It is interesting to note that generally students with high scores in English also have high scores in chemistry, and the students with low scores in English also tend to make low scores in chemistry.

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[14] Henry E. Garrett, Statistics in Psychology and Education (New York: Longman's Green Company, 1950), p. 272.

[15] Ibid., p. 272.

The Pearson Product Moment Coefficient of Correlation computed from the deviation from the means indicates +.509. This would tend to suggest a fairly high degree of positive correlation between English and chemistry.

Table II--Coefficient of Correlation: Mathematics and Chemistry--on page 20 shows the mathematics scores of 40 students as revealed by the California Achievement Test and the final scores in a nine-month course in high school chemistry on the tenth grade level. The mean score in mathematics is 9.35 and the mean score in chemistry is 74.05.

The Pearson Product Moment Coefficient of Correlation computed from the deveations from the means indicates a +.803. This indicates a very high degree of correlation between mathematics and chemistry.

Table III--Coefficient of Correlation: English and Biology--on page 21 shows the English scores of 40 students as revealed by the California Achievement Test and the final scores in biology associated with a nine-month course in high school biology on the tenth grade level. The mean score in English for this group is 9.92 and the mean score in biology is 75.27.

The coefficient of correlation as revealed by the Pearson Product Moment computed from the deviation from

the means is +.452. This indicates a fair degree of positive correlation between English and biology for this particular group.

Table IV--Coefficient of Correlation: Mathematics and Biology--on page 22 shows the mathematics scores of 40 students as revealed by the California Achievement Test and the final scores in biology received at the end of a nine-month course in high school biology on the tenth grade level. The mean score in mathematics is 9.01 and the mean score in biology is 74.90.

The coefficient of correlation revealed by the Pearson Product Moment computed from the deviation from the mean is +.529. This indicates a fairly high degree of correlation between mathematics and biology for this particular group.

The results of the correlations seem to indicate that both English and mathematics are important for science success, but the correlation between mathematics and science (chemistry-biology) is higher than the correlation between English and science (chemistry-biology). These data suggest that students who make good grades in English and mathematics generally tend to make good grades in science (chemistry-biology). Students who make poor grades in English and mathematics generally tend to make poor grades in science (chemistry-biology).

TABLE I - COEFFICIENT OF CORRELATION
ENGLISH AND CHEMISTRY

Student No.	English Grade	Chemistry Grade	X	Y	XY	X^2	Y^2
1.	14.2	82	3.37	8	26.96	11.2469	64
2.	8.1	64	-2.73	-10	27.30	7.4529	100
3.	8.8	78	-2.03	4	-8.12	4.1509	16
4.	9.5	66	-1.33	-8	10.64	1.7889	64
5.	11.1	75	0.27	1	-0.27	0.0729	1
6.	8.1	60	-2.73	-14	38.29	7.4529	196
7.	7.5	64	-3.33	-10	33.30	11.0889	100
8.	12.3	60	1.47	-14	-20.58	2.1609	196
9.	10.2	68	-0.63	-6	3.78	0.3969	36
10.	7.8	70	-3.03	-4	12.12	9.1809	16
11.	10.4	74	-0.43	0	0.00	0.1849	0
12.	9.4	58	-1.43	-16	22.88	2.0549	256
13.	7.1	58	-1.73	-16	27.68	2.9929	256
14.	11.8	70	0.97	-14	-13.58	0.9409	196
15.	7.6	54	-3.23	-20	64.60	10.4329	400
16.	10.6	70	-0.23	-14	3.29	0.0529	196
17.	9.8	78	1.03	4	-4.12	1.0909	16
18.	10.7	60	0.13	-14	-1.82	0.0169	196
19.	11.0	80	0.17	6	1.02	0.0289	36
20.	13.1	90	2.27	16	36.32	5.1529	256
21.	11.1	88	0.27	14	3.78	0.0729	196
22.	10.0	60	-0.83	-14	11.92	0.6889	196
23.	8.0	58	-2.83	-16	45.28	10.0089	256
24.	14.5	94	3.67	20	73.40	13.4689	400
25.	12.7	88	1.87	14	26.18	3.4969	196
26.	9.8	75	-1.03	1	-1.03	1.0909	1
27.	10.4	90	-0.43	16	-6.88	0.1849	256
28.	9.5	68	-1.33	-6	7.98	1.7889	36
29.	8.4	60	-2.43	-14	34.02	5.9049	196
30.	14.1	88	3.27	14	45.78	10.6229	196
31.	13.6	78	2.67	4	10.68	7.1289	16
32.	14.2	96	3.37	22	74.14	11.2469	484
33.	13.6	88	2.87	14	37.38	7.1289	196
34.	8.4	58	-2.43	-16	38.88	5.9049	256
35.	11.6	70	0.67	-4	2.68	0.4489	16
36.	8.4	60	-2.43	-14	34.02	5.9049	196
37.	4.2	90	3.27	16	53.92	11.2469	256
38.	14.4	96	3.57	22	78.54	12.7449	484
39.	13.8	90	2.87	16	45.92	8.2369	256
40.	13.5	88	2.57	14	35.98	6.6049	196
TOTALS	433.3	2960	0.00	00	712.26	198.3711	7882
Avg.	10.83	74				14.08	88.77

$$r = \frac{\text{Sum XY}}{\text{N. Sigma X Sigma Y}} \qquad \frac{712.26}{40 \times \sqrt{14.08} \times \sqrt{88.77}} \qquad \frac{712.26}{40 \times 3.7 \times 9.42}$$

$$\frac{712.26}{1397.9280}$$

$$r = +.509$$

TABLE II - COEFFICIENT OF CORRELATION
MATHEMATICS AND CHEMISTRY

Student No.	Math. Grade	Chemistry Grade	X	Y	XY	X^2	Y^2
1.	9.30	82	-0.05	7.95	- 0.3975	0.0025	63.2025
2.	7.00	64	-2.35	-10.05	23.6175	5.5225	101.0025
3.	7.40	78	-1.95	3.95	-7.7025	3.8025	15.6025
4.	7.00	66	-2.35	-12.05	28.3175	5.5225	145.2025
5.	7.80	75	-1.55	0.95	-1.4725	2.4025	0.9025
6.	6.80	60	-2.55	-14.05	35.8275	6.5025	197.4025
7.	6.10	64	-3.25	-10.05	32.6625	10.5625	101.0025
8.	8.10	60	-1.25	-14.05	17.5625	1.5625	197.4025
9.	6.50	68	-2.85	-6.05	17.2425	8.1225	36.6025
10.	6.80	70	-2.55	-4.05	10.3275	6.5025	16.4025
11.	9.40	74	-0.05	-0.05	-0.0025	0.0025	0.0025
12.	8.90	58	-0.45	-16.05	7.2225	0.2025	257.6025
13.	6.60	58	-2.75	-16.05	44.1375	7.5625	257.6025
14.	8.00	70	-1.35	-4.05	5.4675	1.8225	16.4025
15.	5.80	54	-3.55	-20.05	71.1775	12.6025	402.0025
16.	9.30	70	-0.05	-4.05	0.2025	0.0025	16.4025
17.	8.80	78	-0.55	3.95	-1.0725	0.3025	15.6025
18.	7.20	60	-2.15	-14.05	30.2075	4.6225	197.4025
19.	10.80	80	1.45	5.95	6.7275	2.1025	35.4025
20.	12.90	90	3.55	15.95	56.6225	12.6025	253.4025
21.	11.50	88	2.15	13.95	29.9825	4.6425	194.6025
22.	6.30	60	-3.05	-14.05	42.8525	9.3025	197.4025
23.	6.70	58	-2.65	-15.95	100.7475	7.0225	257.6025
24.	14.40	94	4.05	16.05	50.9175	25.5025	398.0025
25.	13.00	88	3.65	19.95	1.1875	13.3225	194.6025
26.	10.60	75	1.25	13.95	35.8875	1.5625	0.9025
27.	11.60	90	2.25	0.95	8.1675	4.6225	253.4025
28.	8.00	68	-1.35	15.95	37.2325	1.8225	36.6025
29.	6.70	60	-2.65	-6.05	28.5975	7.0225	197.4025
30.	11.40	88	2.05	-14.05	5.7275	4.2025	194.6025
31.	10.80	78	1.45	13.95	110.8475	2.1025	15.6025
32.	14.40	96	5.05	3.95	42.5425	25.5025	481.8025
33.	12.40	88	3.05	21.95	32.4025	9.3025	194.6025
34.	7.30	58	-2.05	13.95	-8.3025	4.2025	257.6025
35.	11.40	70	2.05	-16.05	41.4475	4.2025	16.4025
36.	6.40	60	-2.95	-4.05	45.4575	8.7025	197.4025
37.	12.20	90	2.85	14.05	106.4575	8.1225	253.4025
38.	14.20	96	4.85	15.95	45.4575	23.4225	481.8025
39.	12.20	90	2.85	21.95	42.5325	8.1225	253.4025
40.	12.10	88	2.75	13.95	38.3625	7.5625	194.6025
TOTALS	374.10	2962	0.00	00.00	1215.1800	272.6000	6598.3000
Avg.	9.35	74.05				16.61	81.22

$$r = \frac{\text{Sum XY}}{\text{N. Sigma X. Sigma Y}} \qquad \frac{1215.1800}{40 \times \sqrt{16.51} \times \sqrt{81.22}}$$

$$\frac{1215.1800}{40 \times 4.06 \times 9.01} \qquad \frac{1215.1800}{1463.2240}$$

$$r = +.803$$

TABLE III - COEFFICIENT OF CORRELATION ENGLISH AND BIOLOGY

Student No.	Eng. Grade	Biology Grade	X	Y	XY	X^2	Y^2
1.	10.4	72	0.48	- 3.27	- 1.5696	0.2304	10.4229
2.	10.1	74	0.18	- 1.27	- 0.2286	0.0324	1.6129
3.	7.6	60	-2.32	-15.27	35.4264	5.3724	233.1729
4.	7.4	66	-2.52	- 9.27	23.3594	6.3504	85.9329
5.	8.4	80	-1.52	4.63	- 7.0376	2.3104	21.4369
6.	10.8	76	0.88	0.63	0.5544	0.7744	0.3969
7.	10.6	80	0.68	4.63	3.0684	0.4624	21.4369
8.	11.8	88	1.88	12.63	23.7444	3.5344	159.5169
9.	9.0	60	-0.92	-15.27	14.0484	0.8464	233.1729
10.	11.4	84	1.48	8.63	14.3724	2.1904	74.4769
11.	9.1	60	-0.82	-15.27	12.5214	0.6724	233.1729
12.	12.1	88	2.18	12.63	27.5334	4.7524	159.5169
13.	11.2	88	1.28	12.63	16.1664	1.6384	159.5169
14.	8.2	60	1.72	-15.27	-26.2644	2.9584	233.1729
15.	10.2	78	0.28	2.63	0.7364	0.0784	7.8169
16.	11.4	84	1.58	8.63	15.6354	2.5164	74.4769
17.	10.4	76	0.48	0.63	0.3024	0.2304	0.3969
18.	11.4	80	1.48	4.63	6.7724	2.1904	21.4369
19.	7.6	60	-2.32	-15.27	35.4264	5.3724	233.1729
20.	10.4	80	0.48	4.63	2.1424	0.2304	21.4369
21.	13.9	94	3.98	18.63	74.1474	15.8404	347.0769
22.	10.8	70	0.88	- 5.27	- 4.6376	0.7744	27.7729
23.	9.6	74	-0.32	- 1.27	0.4064	0.1024	1.6129
24.	13.4	90	3.48	14.63	50.9124	12.1104	214.0369
25.	10.6	80	0.68	4.63	3.0684	0.4624	21.4369
26.	9.8	74	-1.12	- 1.27	0.1524	0.0144	1.6129
27.	9.6	76	-0.32	0.63	0.2016	0.1024	0.3969
28.	10.4	80	0.48	4.63	2.1424	0.2304	21.4369
29.	9.2	80	-0.72	4.63	- 3.3336	0.5184	21.4369
30.	8.8	72	-1.12	- 3.27	3.6624	1.2542	10.4229
31.	8.4	70	-1.52	- 5.27	8.0104	2.3104	27.7729
32.	6.2	60	-3.72	-15.27	56.8044	13.8384	233.1729
33.	9.2	75	-0.72	- 0.27	0.1944	0.5184	0.0729
34.	10.2	78	0.28	14.63	0.7364	.0784	7.8169
35.	6.4	60	-3.52	2.63	53.7504	12.3904	233.1729
36.	8.8	70	-1.12	-15.27	5.8024	1.2542	27.7729
37.	7.5	70	-2.42	- 5.27	12.7534	5.8564	27.7729
38.	7.3	60	-2.62	- 5.27	13.8074	6.8644	233.1729
39.	13.6	90	3.68	-15.27	53.8384	13.5424	214.0369
40.	13.6	94	3.68	18.63	68.5584	13.5424	347.0729
TOTALS	396.8	3011	0.00	00.00	506.1200	154.3492	4004.6760
Avg.	9.92	75.27				12.42	63.27

$$r = \frac{\text{Sum XY}}{\text{N. Sigma X Sigma Y}} \qquad \frac{506.1200}{40 \sqrt{12.42} \times \sqrt{63.27}}$$

$$r = \frac{506.1200}{40 \times 3.52 \times 7.95} \qquad \frac{506.1200}{1119.3600}$$

$$r = +.452$$

TABLE IV - COEFFICIENT OF CORRELATION
MATHEMATICS AND BIOLOGY

Student No.	Math. Grade	Biology Grade	X	Y	XY	X^2	Y^2
1.	8.5	72	-0.51	- 2.90	1.4790	0.2605	8.4100
2.	9.2	74	0.19	- 0.90	- 0.1710	0.0361	0.8100
3.	6.1	60	-2.91	-14.90	43.3590	8.4681	222.0100
4.	5.4	60	-3.61	-14.90	53.7890	13.0321	222.0100
5.	6.8	80	-2.21	5.10	-11.2710	4.8841	26.5200
6.	10.2	76	1.19	1.10	1.3090	1.4161	1.3200
7.	8.4	80	0.61	5.10	- 3.1110	0.3721	26.5200
8.	11.4	88	2.39	13.10	31.3090	5.7121	171.6100
9.	8.0	60	-1.01	-14.90	15.0490	1.0210	222.0100
10.	10.4	84	1.39	9.10	12.6490	1.9321	82.8100
11.	6.8	60	-2.21	-14.90	32.9290	4.8841	222.0100
12.	11.2	88	2.19	13.10	28.6890	4.7961	171.6100
13.	11.0	88	1.99	13.10	26.0690	3.9601	171.6100
14.	7.4	60	-1.61	-14.90	23.9890	2.5921	222.0100
15.	9.2	78	0.10	3.10	0.5890	0.0361	6.6100
16.	10.8	84	1.79	9.10	16.2890	3.2041	82.8100
17.	9.6	76	0.59	1.10	0.9490	0.3481	1.3200
18.	10.2	80	1.19	5.10	6.0690	1.4161	26.5200
19.	6.4	60	-2.61	-14.90	38.8890	6.8121	222.0100
20.	9.8	80	0.79	5.10	4.0290	0.6241	26.5200
21.	12.4	94	3.39	19.10	64.7490	11.4921	364.8100
22.	9.4	70	0.39	- 4.90	- 1.9110	0.1521	24.0100
23.	8.0	74	-1.01	0.90	- 0.9090	1.0201	0.8100
24.	11.4	90	2.39	15.10	36.0890	5.7121	228.0100
25.	10.2	80	1.19	5.10	6.0690	1.4161	26.5200
26.	6.5	60	-2.51	-14.90	37.3990	6.3001	222.0100
27.	6.4	70	-2.61	- 4.90	12.7890	6.8121	24.0100
28.	8.1	70	-0.91	- 4.90	4.4590	0.1981	24.0100
29.	5.7	60	-3.30	-14.90	49.1700	10.8900	222.0100
30.	14.1	90	5.09	15.10	76.8590	25.9018	228.0100
31.	9.0	94	-0.01	19.10	0.1910	0.0001	364.8100
32.	8.5	80	-0.51	5.10	- 2.6010	0.2605	26.5200
33.	6.2	70	2.81	- 4.90	-13.7690	7.8961	24.0100
34.	9.2	60	-0.19	-14.90	- 2.8310	0.0361	222.0100
35.	7.5	70	-1.51	- 4.90	7.3990	2.2801	24.0100
36.	13.0	74	3.99	0.90	3.5910	15.9201	0.8100
37.	6.9	72	-2.11	- 2.90	6.1190	4.4521	8.4100
38.	9.6	74	0.59	0.90	0.5310	0.3481	0.8100
39.	9.4	76	0.39	1.10	0.4290	0.1521	1.3200
40.	10.2	80	1.19	5.10	6.0690	1.4161	26.5200
TOTALS	360.5	2996	0.00	00.00	612.0890	168.4624	4202.5000
Avg.	9.01	74.90				12.90	64.82

$$r = \frac{\text{Sum XY}}{\text{N. Sigma X. Sigma Y}} \qquad r = \frac{612.0890}{40 \times \sqrt{12.90} \times \sqrt{64.82}}$$

$$r = \frac{612.0890}{40\ \sqrt{12.90} \times \sqrt{64.82}} \qquad \frac{612.0890}{1155.9800}$$

$$r = +.529$$

CHAPTER IV

SUMMARY AND CONCLUSIONS

A. Summary. A study was made of forty tenth grade students in a chemistry course and forty in a tenth grade biology course at Lincoln High School, Port Arthur, Texas. A comparison was made between their performances in these courses and their achievement in English and mathematics as revealed by the California Achievement Test.

The coefficient of correlation by the Pearson Product Moment computed from the deviation from the mean indicated the following results:

1. Correlation between chemistry and mathematics .803
2. Correlation between chemistry and English .509
3. Correlation between biology and English .452
4. Correlation between biology and mathematics .529.

B. Conclusions. Prediction in the perfect sense is not possible in this or in most other situations, but prediction in terms of estimating chances for success is inescapable in human affairs.

Perfect prediction is not possible, but it is feasible to speak concerning an individual's probable

chances of achievement or adjustment and in doing so consideration must be given to all variables which will influence the individual's progress.

The results of this investigation suggest that mathematics and English proficiency are significant variables which should be given attention the prediction of success in the case of the study of science.

Interesting, too, is the observation that mathematics is highly correlated with success in science classes than is English. More specifically, the degree of correlation between mathematics and chemistry is higher than the correlation between English and chemistry. The correlation between mathematics and biology is higher than the correlation between English and biology.

C. Final reflections. Surveys seem to indicate that students who score high in mathematics and English tend to have greater success in science than students who score low in mathematics and English.

Considering all variables it seems as though English and mathematics are basic factors to consider in studying or preparing for a career in science. Students with good mathematics and English backgrounds may be expected to have more success in science than students with low or poor backgrounds in these areas, other factors being equal.

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